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Maturity of IT-Business alignment – an assessment tool

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Abstract

Enterprise systems hold a large promise for organisations to enhance their strategic position. However, adoption and implementation of enterprise systems is not without problems. Many problems have been reported in the literature with implementation of new technology, many of which seem to recur over and over again. It seems difficult for organisations to learn from previous experience and successfully organise and manage complex dynamic projects like an enterprise system implementation project.

Although current project and change management methods offer support in organising and managing complex projects, more is needed to increase insight into the specific situation at hand. In this chapter, research is presented aimed at collecting knowledge on the dynamics of enterprise system implementation projects. The knowledge can serve to increase awareness of potential risks and pitfalls in specific new enterprise system implementation situations. To make the knowledge accessible a tool has been developed for assessing a start-up situation of an enterprise system implementation project in an organisation. The key concept in this assessment is the level of mutual alignment between various organisational aspects of the business in which the system is implemented, the enterprise system, and the implementation project.

Keywords: Enterprise system implementation; IT-business alignment, Assessment

1. Introduction

More and more enterprise systems are implemented and used in organisations to support enterprise-wide processes. Such processes involve several departments in an organisation or even may cross organisations' borders (see e.g., Davenport, 2000). Examples of enterprise-wide processes are the order-throughput process from customer order to finished product, including purchasing and distribution, and the design and engineering process from idea to product specification, including, possibly early, transfer of information to downstream processes. A well-known enterprise system is an enterprise resource planning (ERP) system, which supports all processes involved in processing customer orders. Another example is a product data management (PDM) system, which supports management of lifecycle aspects of product information. Knowledge management (KM) is yet another solution to managing enterprise-wide information.

Despite the many potential advantages, implementation of an enterprise system is not without problems. About half of all implementation projects only partly meet the envisioned goals or fail completely (see e.g., KPMG, 2002; Nash, 2000; Kwon & Zmud, 1987). Many other projects may meet the goals, but only by consuming considerably more resources than budgeted. In the literature, many dos and don'ts have been described as well as success and failure factures (see e.g., Adam & O'Doherty, 2000). In addition, many best-practice project management approaches and change management methods are offered that can support people in successfully implementing an enterprise system (Lozinsky, 1998; Callaway, 1999; Bancroft, Seip & Sprengel, 1997; Welti, 1999). However, the dos and don'ts and best practices do not sufficiently guide people in organisations in managing a complex process like implementing an enterprise system. Available guidelines and methods apparently are abstracted from real contexts and are difficult to specify for specific situations.

Moreover, in practice, most of the identified problems seem to reoccur over and over again as can be concluded from a vast amount of literature on real-life experiences

with implementing new technologies (see e.g., Ruël, 2001; Davenport, 2000). The problems reported are multi-faceted. They are both technical and organisational in nature, with less than 10% of a technical nature. The majority of problem is related to organisational and human issues (Bikson & Gutek, 1984). It seems that in real practice insight into the specific situation at hand is insufficient for engaging in and managing an enterprise system implementation project.

Enterprise system implementation projects are inherently complex and dynamic, which means that the process and its outcomes cannot be fully predicted. Technology and organisation need to co-develop during an implementation project (Leonard-Barton, 1988; Orlikowski & Robey, 1991), which means that the envisioned outcomes for technology and organisation may change during the project. Moreover, the course of the project may change due to internal and external disturbances or unexpected new opportunities. Although current project and change management methods offer support for managing such projects, they need to be complemented with methods to increase insight into the specific situation in which an enterprise system is to be implemented.

There is a large need for people with extensive experience of managing complex projects. Such people could be consultants who have been guiding and managing many projects in various companies. In-depth experience is, however, scarce. Similarly, people in organisations may have gained experience in earlier implementation projects. Knowledge in organisations may, however, fade away due to possibly large time lag between implementation projects or because people may leave the organisation. The question is how people and organisations can learn from previous experience gained in other similar situations. The challenge is to collect such experiences and transfer them into a tool for increasing awareness of the areas that need attention in a specific implementation situation. With such a tool the start of an implementation project would be improved by the ability to anticipate situation-specific risks and problems.

In this chapter, a tool is presented for assessing the readiness of an organisation to start an enterprise system implementation project. The tool is the result of research performed in the BEST project (Wognum et al., 2004). The research was aimed at capturing experiences of enterprise system implementation projects and making these available to other projects through the tool. The resulting tool is based on the view that implementation of an enterprise system occurs in a socio-technical system in which several systems co-exist (see section 3). The degree of alignment between these systems is a measure of the readiness of an organisation.

We will address two questions in this chapter:

1. What needs to be considered in anticipating problems in an implementation project? To answer this question, a model is needed incorporating relevant aspects of a socio-technical system, as well as a model of the systems that co-exist during an implementation project. Such a model will be suited to capture and structure knowledge of real-life implementation projects.
2. What potential problems can be expected in the start-up phase of a particular implementation project? To answer this question, a tool will be presented that visualises the weak areas that need attention in a specific situation. The potential risk areas are rated on a maturity scale that indicates the degree of alignment between the different co-existing socio-economic systems.

The questions above will be addressed in the following sections. Section 2 will present the background of enterprise systems and their use for current organisations. The need for an architectural view will be explained. In section 3 the architectural

view adopted for the presented research will be presented. Section 4 briefly presents the research performed and the results gained. Section 5 introduces the tool for assessing the readiness and maturity of an organisation to start an enterprise system implementation project. This chapter ends with a summary and ideas for further research.

2. Background

Business functions, business units and companies become more and more connected all around the globe to meet the challenges of current market needs. Interconnectivity requires that information needs to flow seamlessly across the various boundaries (Davenport, 2000). Enterprise-wide information systems are implemented to generate, store, retrieve, share and transfer information across the company and beyond. Enterprise resource planning systems (ERP), for example, manage information throughout the whole order-throughput process, from order intake to product delivery, from supplier to distribution, involving many different business functions or even supply chain partners. Product data management (PDM) systems manage data throughout the whole design and engineering process involving downstream processes where needed and, possibly, suppliers and design partners. Web technology is increasingly being integrated with enterprise information systems to enable the transfer of information between companies (Laudon & Laudon, 2004).

The most important characteristic of enterprise systems is that data is centrally managed and can be accessed by all business functions inside and outside the company that are involved in the supported business process. Central data management requires shared agreement on data definitions and formats across the various business functions. Other agreements involve the streamlining of processes and workflow to achieve integration between the various business functions (Laudon & Laudon, 2004).

Enterprise systems have several characteristics that need to be taken into account when implementing such systems in an organisation (Markus & Tanis, 2000):

- They integrate information flows through a company – involving, e.g., financial and accounting information, human resources information, supply chain information.
- They are commercial packages bought from or leased by software vendors. This means that traditional IT skills are not sufficient for implementing a software package like an enterprise system, while organisational requirements and processes need to be mapped to the processes and terminology embedded in the enterprise system. Organisations need to manage their dependency on vendors.
- They are based on best practices, which force organisations to adapt to a less proprietary way of working. Often considerable redesign of a company's processes is needed, also influencing organisational structure, tasks, workflow, etc.
- Assembly is needed of the enterprise system with the company's existing infrastructure, legacy systems, or modules or programs from other vendors. Markus & Tanis (2000) state that today's enterprise systems do not yet meet all the information-processing needs of the majority of organisations.
- Evolution of enterprise systems is continuously happening to meet the changing demands of current business involving continuous updates of a company's enterprise system and accompanying organisational changes.

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The impact of enterprise systems on the organisation is, however, often underestimated (Davenport, 2000). Many enterprise system implementation projects are still considered to be a responsibility of the IT people in the organisation. This fact is often mentioned as an important reason for failure. In selecting and adopting an enterprise system a thorough analysis is needed of many aspects of the organisation, such as business strategy, business processes and tasks, organisational culture, existing infrastructure and systems and people knowledge and skills. Top management cannot sit aside in this process.

Many problems are reported in the literature in the past decades with implementing new technology in an organisation. Many problems seem to recur and are not restricted to one type of technology (see e.g., Ruël, 2001; Boer, 1990; Markus & Tanis, 2000). Despite of the many different situations, some regularities can be found, which may help people in managing an implementation project. Project and change management methods have been developed to manage complex projects and offer methods to manage or prevent many of the common problems. However, despite of the availability of advanced project and change management methods, problems still keep appearing.

The process of implementing an enterprise system is extremely complex and different for each different situation. Moreover, technology implementation projects are not deterministic. Even with similar starting situations, outcomes may be different (see e.g., Barley, 1986). An implementation project is dynamic, because at any phase different things can go wrong, problems may stay unnoticed for a while, many actors are involved with their own perspectives and goals, business situations may change, a wide range of decision options exist, etc. Moreover, system and organisation co-develop (Leonard-Barton, 1988). People influence the way a system is used (Orlikowski, 1992) possibly leading to adaptations to the system, while better understanding of the system might lead to identification of new opportunities for the organisation, which requires additional organisational changes.

Implementing an enterprise system requires a team approach involving many different disciplines, technical as well as organisational, and several organisational levels, from top-level management to the worker level. Experience of implementation projects is indispensable. However, in-depth experience is scarce. Similarly, implementation knowledge in organisations may fade away due to possibly large time lag between implementation projects or because people may leave the organisation. The question is how people and organisations can gather knowledge and learn from previous experience gained in other similar situations. The challenge is to collect such experiences and make them available for increasing awareness of the areas that need attention in a specific implementation situation. In this way, the start of an implementation project would be improved by the ability to anticipate situation-specific risks and problems.

In the EC project BEST (Better Enterprise SysTem implementation)[1] case studies have been performed to capture dynamics of enterprise system implementation projects. Process fragments have been gathered that represent an unexpected or undesired course of action. As such, the process fragments serve as mini-cases of real-life experiences of enterprise system implementation projects. By reading such mini-cases people may better understand their own situation and improve their own implementation project. The mini-cases have been used to build a tool for identifying

[1] BEST (Better Enterprise SysTem implementation) is a project within the Information Systems (IST) domain of the fifth Framework Programme of the European Union. It started in June 2002 and finished in November 2004 (www.best-project.com).

possibly weak or problematic situations at the start of a new enterprise system implementation project (Wognum et al., 2004). The tool also offers an index to the set of mini-cases that are relevant to a specific start-up situation.
The tool offers a snapshot of a company at the start of adopting an enterprise system. The snapshot shows weak areas of the implementation project to start. By increasing awareness of the potential risks involved, the tool may support establishing conditions that may be necessary for achieving a successful outcome. However, these conditions may be necessary, but are not sufficient. Because of the dynamic and emergent nature (Soh & Markus, 1995) of enterprise system implementation projects as argued above, adequate project and change management methods are indispensable. Repeated snap-shots may be needed to redirect and change the course of the project.

3. Enterprise architecture and social dynamics

The main challenge of implementing an enterprise system in an organisation is to achieve alignment between the system and the organisation. Achieving alignment requires an integrated approach to all aspects of an organisation, technical as well as organisational. Enterprise architecture may offer an important support for achieving such integration (Lankhorst, 2004). In this chapter, we will not discuss modelling languages or tools for enterprise architectures, but we will discuss the elements and relationships of an enterprise architecture that offers an integrated analytic view on the processes involved in implementing an enterprise system.
The research performed in the BEST project is based on a system view of organisations (see e.g., Flood and Jackson, 1991; Daft, 2004). An organisation is viewed as a socio-technical system in which technology and organisation need to be aligned with each other to achieve the organisational goals. In a socio-technical systems approach, many different disciplines, technical as well as social, need to collaborate (Laudon & Laudon, 2004). Below, we introduce the socio-technical system approach adopted in the BEST project, which serves as the basis for the resulting enterprise architecture.

3.1 Enterprise architecture

In the systems view an organisation is viewed as a purposeful whole in which people perform processes with the help of means, like methods and tools to satisfy certain needs in the environment of the organisation (Boer and Krabbendam, 1993). Processes transform inputs of material and/or information into outputs, which are products and/or services needed in the environment. The processes directly aimed at achieving the goals of the organisation are called primary processes. The primary processes are controlled and buffered against disturbances from the environment by management processes, which consist of strategic, adaptive and operational management processes. Strategic processes determine the long-term goals and strategy of the organisation including the performance goals (see e.g., Slack et al., 1998). Adaptive management implements these goals into suitable organisational configurations. Operational processes manage the daily processes within the goals and strategy set by strategic management. To perform the primary, management, and support processes sufficient and sufficiently qualified people and means are necessary for which support processes are responsible. Finally, organisational arrangements consist of all formal and informal structural and cultural relationships between people, between means and between people and means in an organisation. An architectural view on an organisational system for a manufacturing organisation is depicted in figure 1, which can be considered an enterprise architecture. The model has been used

as a component in an architecture of a virtual organisation to identify essential capabilities needed for mature performance (Wognum and Faber, 2002).
In the enterprise architecture as presented in figure 1, the processes have not been explicitly subdivided into management, primary and support processes. Processes consist of activities, each of which also may consist of lower-level activities until basic activities are reached. The architecture shows the information on the process and product that flows between activities. Two types of process activities have been distinguished, transformation and communication activities. Transformation activities transform input information into output information. Examples of such activities are the transformation of product requirements into a conceptual design in a product development process. Similarly, information on the product status in order processing is transformed when the order is processed (the architecture does not show the material flow). Communication activities transfer information from one activity to another and, as such, between the people that perform the activities. The document flow between activities represents the formal communication in a company, for example. Information on the product and process is important to consider when implementing an enterprise system, e.g., a PDM system for supporting a product development process.

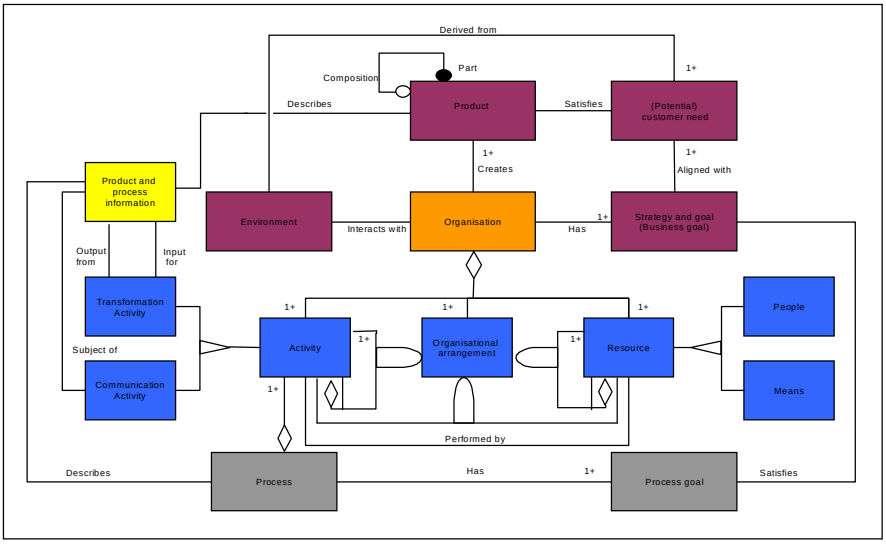

Figure 1 Architectural model of a manufacturing organisation

A system is more than the sum of its elements (Flood and Jackson, 1991). The behaviour of a system as a whole cannot be found in any of its elements. A system view, therefore, is a holistic view. It is possible to analyse parts or aspects of a system, but without taking into account their relationships with other parts or aspects, conclusions may not be very reliable. A system view is, moreover, an analytic way to focus analysis on a coherent part of the world.
Determining system borders is an important part of organisational analysis and design. Examples of systems to be analysed are the manufacturing process (Boer, 1990), the R&D process (Weerd-Nederhof, 1998), or the collaborative design process between organisations (Faber, 2001). Determining system borders and the relevant system elements starts with selection of a focus process. The enterprise architecture presented in figure 1 may represent various primary processes in a manufacturing environment.

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In case of an enterprise system implementation project, selecting a focus process is not very simple. Focusing only on the project process is not sufficient. Focusing only on the business process that is impacted by the enterprise system on the other hand might lead to ignorance of the project and change process. Moreover, the enterprise system itself is also a system with a business process embedded in it with a related workflow and dataflow and task definition, which need to be tuned to the business process and vice versa. An enterprise architecture for an enterprise system implementation project should incorporate these three processes (see section 3.3).

In an enterprise implementation project, an enterprise architecture must be supplemented by a detailed process model in which the different activities and the transformation and flow of information can be recognised. Such a model can be compared with best practice models as, for example, are offered by enterprise system package vendors (see e.g., www.sap.com). Comparison of the process models will help in determining the changes needed in the business process. More is needed, however, to estimate the amount of effort needed to implement an enterprise system as we will describe below. An enterprise architecture helps in determining the areas of attention. This also means that enterprise architectures should differ for different application areas. In section 3.3, an enterprise architecture for enterprise system implementation will be presented.

Modelling important elements and relationships is not sufficient. To analyse if and how an organisation achieves its goal the behaviour of an organisation needs to be studied. Below, organisational behaviour is discussed in more detail.

3.2 Social dynamics

The processes performed in an organisational system determine its behaviour. Processes are expected to proceed as designed, i.e., as laid down in process schemes and process handbooks in ISO certified companies. However, this is often not the case, not only because of unexpected disturbances like broken machines or insufficient supplies, but also because of the culture, politics, power and other aspects involved in collaboration between people (Schein, 1996).

Organisational arrangements as introduced above provide the glue between the other elements of the organisation. They consist of the formal and informal arrangements, the structure and culture of an organisation which allow material and information to flow from one process step to another and support communication between people.

The structure and culture of an organisation consist of various normative relationships between the elements in an organisation. Normative relationships are not only the organisational hierarchy, reporting relationships, process structure, infrastructure, team structures, normative procedures and routines, but also the values, rules and norms that constitute a relatively coherent and consistent set of beliefs and prescriptions that govern the behaviour of people (Scott, 1992). The normative relationships can be considered to constrain and channel human behaviour in the organisation.

On the other hand, actual behaviour often differs from behaviour intended in the normative part of the organisational arrangements. This actual behaviour depends not only on individual human characteristics, but also on relationships and interactions between people. Commitment, attitude, sentiments, conflicts, autonomous activities are examples of characteristics that influence organisational behaviour.

There is a duality (Giddens, 1984) between normative and actual behaviour in an organisation. Actual behaviour may shape the normative relationships, while

normative relationships shape behaviour. In this chapter, we will use the term social-dynamics to indicate actual behaviour.

3.3 An enterprise architecture for enterprise system implementation

The architectural model presented above has been used in the BEST project to frame thinking and structure knowledge on the process of enterprise system implementation. As indicated above, in an enterprise system implementation project several organisational systems co-exist (see e.g., Lange-Ros, 1999). These systems may need separate configurations and may behave differently. In the socio-technical view these systems need to be internally as well as mutually aligned for achieving successful implementation. While organisational theories may support internal alignment (see e.g., Daft, 2004), mutual alignment requires understanding the different needs and characteristics of the different organisational systems.

The first system that can be recognised is the permanent business, which needs to proceed as usual during an implementation of a new enterprise system, while at the same time gradually adapting to the new situation. The second system is the implementation project, which requires specific resources, processes and structure. The third system is the process to configure and tune the enterprise system with its embedded processes and structure. Each of the three systems can be studied apart from the others, although the distinction is purely analytic. In practice, the three systems interact and are mutually dependent. They need to be aligned to achieve success. For example, people involved in the implementation project need to have sufficient knowledge and skills to enable them to understand differences between their daily situation and the project, with respect to respective tasks and ways of working.

	Enterprise system	**Project management**	**Permanent business**
Strategy and goals			
Management			
Structure			
Process			
Knowledge and skills			
Social dynamics			

Figure 2 Enterprise architecture for enterprise system implementation

The model has been applied to each of the three organisational systems, with their own focus processes. These organisational systems are called dimensions. Initially the full model was used in an initial step to gather knowledge from experts in enterprise system implementation. Experts, like enterprise system implementation consultants, have been asked to write down their experiences of past implementation projects. They had to remember events that have influenced the course of the implementation project, the perceived causes of these events, the actions that were taken to react to the

events, and the eventual outcomes of these actions (see also section 4). The causes of the events have been put into one of the dimensions and one of the organisational elements, which are called aspects. Based on the outcomes of this step, the initial model was reduced to the model depicted in figure 2.

The external part of the architectural model has been left out, while the number of remaining elements, called aspects, has been reduced. We will explain the aspects that have remained part of the model, below:

- *Strategy and goals.* Strategy and goals are the medium- and long-term goals to be achieved and the plans for realising these goals. The strategy and goals for the enterprise system and the implementation project should be explicit and should match the business goals and strategy.
- *Management.* The management aspect deals with setting priorities, assigning resources and planning and monitoring the process. Business management in this respect differs from project management.
- *Structure.* Structure involves the normative relationships between elements of the organisational system. Examples are process structure, hierarchy, team structure or technical architecture. The process structure of the enterprise and the enterprise system belong also to this aspect. Process structure reflects the (formal) flow of information and material.
- *Process.* Process involves the steps that are needed to perform the focus process of each dimension: the primary business process and relevant support processes, the project process, and the enterprise system design and adaptation process. This aspect reflects the different activities.
- *Knowledge and skills.* This aspect refers to the knowledge and skills that are needed to perform the focus processes in each dimension. As indicated above, the knowledge and skills needed for each of the focus processes are different.
- *Social dynamics.* This aspect concerns the actual behaviour of people individually or in groups. Social dynamics often become visible in informal interaction and (lack of) communication.

The dimensions and aspects together form an enterprise architecture for enterprise system implementation. In figure 2, the full socio-technical architecture used in the BEST project is depicted. This architecture covers part of the enterprise architecture of figure 1. The purpose of this chapter is not to specify a formal enterprise architectures. Instead, this chapter aims at presenting an approach to use the content and structure of an enterprise architecture to understand real-life problems in implementing enterprise systems.

The enterprise architecture of enterprise system implementation is used for structuring thought and knowledge. The experiences collected in the BEST project are classified into the cells of the architecture, thus populating the architecture with specific knowledge. In this way, more in-depth knowledge of each of the cells is achieved. The architecture may serve as such as a reference model for enterprise system implementation.

4. Capturing knowledge

Research methods like surveys and questionnaires are not very suited to gather knowledge on process dynamics and understand context influences. Instead, in-depth case studies are needed. A case study is a research methodology suitable to understand process dynamics within specific contexts (Miles & Hubermann, 1984). Yin (1994) and Eisenhardt (2000) have developed systematic and rigorous approaches

for developing theory through comparative case studies. In particular, Eisenhardt has developed a roadmap for building theory from case study research, which synthesizes Miles and Hubermann's (1984) work on qualitative methods, design of case study research by Yin (1994), and grounded theory building by Glaser and Strauss (1967). It extends this work in areas such as a priori specification of constructs, triangulation of multiple investigators, within-case and cross-case analysis, and the role of existing literature (Eisenhardt, 2000).

The initial constructs used in the BEST project are the cells of the enterprise architecture of figure 2, which have been specified for capturing experience of enterprise system implementation projects. The architecture incorporates a socio-technical view because mutual alignment between the organizational aspects and between dimensions is assumed. Each dimension incorporates both technical and organizational aspects. Triangulation has been realized, because multiple investigators have been involved in several parts of Europe, while several sources of knowledge have been used (see below). The knowledge gathered allows for within-case and cross-case analysis. Within-case analysis has been performed in performing the case study and feeding the results back to the respective company. The research in BEST has focused on cross-case analysis. For this purpose context characteristics have been identified for distinguishing different interesting subclasses of the knowledge gathered. The results will be described in section 5.

Because of the time frame available in the BEST project, retrospective case studies have been performed. Different actors who have been involved in an enterprise system implementation project have been interviewed according to a particular protocol. Actors with different roles have been selected, such as a senior manager, an end user, a key user, an IT person, a functional manager, and a project manager. Each interview has focused on identification of events that have had a major influence on the course of the implementation project. After putting the events in order of decreasing importance and impact, the top three events were selected for further analysis. For each event, causes as perceived by the interviewees have been identified, as well as actions taken to repair or manage the impact of the events and outcomes for each of the actions. The causes, events, actions, and outcomes are process fragments. Together these process fragments give an impression of the dynamics of the enterprise system implementation project studied.

The construct used to capture the process fragments is the CEAO (cause-event-action-outcome) chain. In total 264 chains have been gathered from 24 cases all over Europe. Typically, for each in-depth case study 10-15 CEAO chains have been gathered. In addition, for each case, context information has been gathered through a demographic questionnaire. This context information allows for cross-case analysis. Different context factors have been defined, such as organizational size, cultural region, type of primary process, type of enterprise system implemented, type of company, etc.

The process fragments can be considered as mini-cases or what-if patterns that can be used to increase learning on what might happen if a problematic situation is not taken care of or has not been recognised. The presentation of such mini-cases to people responsible for an enterprise system implementation project can take the form of:

> IF <sitiation> THEN <possible event> REQUIRING <action> WITH <possible outcome>

The total set of CEAO chains is, however, too large to present in specific situations. An index is needed to reduce the set to contain only those chains that are useful in a specific situation. The chains have been analysed by means of the enterprise architecture of figure 2, which gave them an internal structure and application area.

Each cell in the architecture, filled with the knowledge from the chains, has then served to formulate questions and answers on the level of alignment between dimensions. With the questions and answers a tool has been built for assessing the maturity of the start-up phase of an enterprise system implementation project in terms of level of alignment between dimensions. The analysis of the chains and the resulting tool are presented below.

5. Knowledge analysis

Causes are an important part of CEAO chains. These causes represent situations that have led to situations, called events, which have required people to act and may have changed the course of the project. By identifying situations like the ones mentioned in the causes, weak spots in the start-up phase might be determined allowing proper actions to be taken to prevent potential problems to occur.
Each of the causes of the 264 chains has been assigned to a cell of the enterprise architecture. The resulting distribution of causes is presented in table 1. For the cross-case analysis we refer to another article published on the BEST results (Wognum et al., 2004).

Table 1 Distribution of causes in enterprise architecture

Aspect	Dimension			
	Business	Enterprise system	Project management	Total
Strategy and goals	20	2	3	25
Management	40	4	12	56
Process		22	19	41
Structure	16	27	4	47
Knowledge and skills	24	4	11	39
Social dynamics	32	7	17	56
Total	132	66	66	264

The main problems seem to exist in business management (lack of management support, lack of vision, insufficient assignment of resources), in social dynamics in the business (consisting of user resistance especially in large enterprises), and in enterprise system structure (alignment with business process structure, clarity of embedded process, user interface). The business process as such does not present problems with respect to the implementation project.
To illustrate the analysis process we will give an example of assigning a cause of a CEAO chain to a cell in the enterprise architecture. In table 2, a specific CEAO chain is presented as well as the specific cell to which the chain's cause has been assigned. Thorough knowledge on the fundamentals of the enterprise architecture is needed to perform the cause analysis. Nevertheless, the analysis process has been performed by the research team of the BEST project consisting of seven people. After an initial learning process most causes have been assigned to one cell unanimously.

Table 2 An example of a CEAO chain and assignment of cause to enterprise architecture

CEAO chain		
	Text	Assignment
Cause	People have limited time for internal projects. It is hard to find only the most	Business/Management

	capable people in the organisation that are available for internal projects.
Event	No priority on internal projects. Resources are limited for internal projects.
Action	1. Project plan adjusted by mutual agreement with consultant 2. People in project team have been carefully chosen. Only people with empathy for the ESI project are selected
Outcome	1. Postponement of deadlines 2. Expectation of a positive influence of the chosen persons. Not all departments have carefully chosen the right people, thus limiting the marketing of the enterprise system in their department

The resulting contents of the cells of the enterprise architecture have been translated into questions and related answers options. An example of one question-answer pair is given in table 3.

Table 3 Example of question-answer pair

Question (Business/ management)	What is the priority of the Enterprise System Implementation project?
Answers	1. The project is very important for us 2. Day-to-day business has priority over the internal project 3. Enterprise System priority is only high during project life 4. Project priority is highly dependent on other internal projects 5. Project priority is low

Each of the answer options are rated on a scale of 0 – 4, where 0 means no alignment between dimensions and 4 means optimal alignment between dimensions. The score of optimal alignment is considered as the benchmark for the final score. With the questions and answer options a tool has been built for assessing an organisation's readiness for enterprise system implementation.

6. Assessment tool

The tool built in the BEST project is a prototype that will be subject to further adaptation and development based on additional knowledge gathered through in-depth case studies. A session with the user of the tool consists of filling in the user details and filling out all answers in the tool. For each cell in the enterprise architecture, two or more questions with accompanying answers have been formulated. In figure 3, the output of a specific session with the tool is depicted.

After a session, CEAO chains relevant for the specific company are shown, from which the most applicable ones can be selected. From a repository of improvement actions, relevant ones are shown. This option is especially useful for a consultant

supporting a company in selecting and adopting an enterprise system. With his or her knowledge, the relevant chains and improvement actions can be selected. The option is also useful to people in a company who want to learn about potential problems that may occur.

The tool has been validated with 10 experts related to the BEST consortium, with 11 companies and with 10 external experts. The overall performance, reliability, easiness to be understood, easiness to be learned have all been rated as good, while the capability to be maintained and adapted has been rated as average. The coverage of common risk elements, the logic of the tool structure, the consistency between constructs and cases and literature, characterisation of aspects and dimensions have been rated as good. The feeling about questions and answers, the presentation of questions and answers, the scoring mechanism of question and answers and the integration of tool components have been rated good. Finally, attractiveness to practitioners, business value, and innovativeness have all been rated as good.

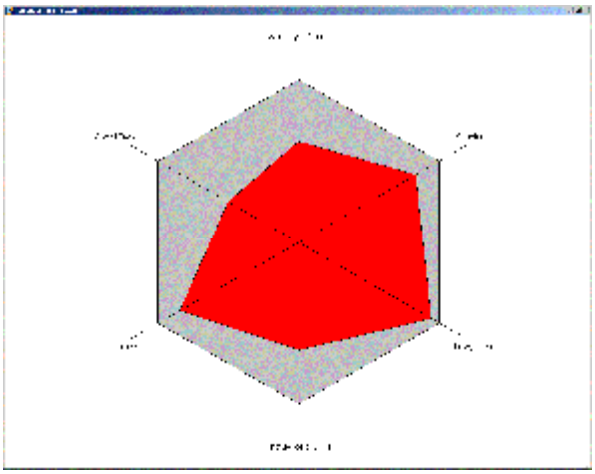

Figure 3 Spider diagram resulting from the prototype tool

Although the tool still requires adaptation and improvement before commercial use will be possible, the results are promising. The tool helps a company to understand its own situation, anticipate potential problems and decide on taking actions to prevent these problems to occur. The knowledge captured shows real process fragments, which trigger thoughts in other, similar, situations. Although the problems captured can also be found in the literature, the tool provides a means to develop a comprehensive overview of and insight into all dimensions and aspects that play a role in implementing a new enterprise system and puts problems into perspective. Moreover, the tool supports a company in focusing on those areas that may need specific attention.

The tool is considered particularly useful for a project manager of an enterprise system implementation project preferably assisted by a consultant with extensive experience of such implementation projects. The tool is meant to be used at the start of an implementation project to discover areas that require attention. The tool can also be used during an implementation project, especially when the project has changed its course of action or its goals.

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7. Summary and further research

In this chapter, an approach has been presented for capturing and reusing knowledge on the dynamics of enterprise system implementation projects. Process fragments have been captured in a cause-event-action-outcome construct called CEAO chain. The knowledge has been used for building a prototype tool for assessing the start-up situation of a new enterprise system implementation project. The tool has proven to be powerful in determining weak spots and triggering ideas for improvement.

The tool is based on a socio-technical system view in which technology and organisation co-exist and need to be aligned. The tool offers support in identifying those problems that are relevant for the situation at hand. In this way suitable measures can be taken. This approach refines current literature and project and change management methods in reducing efforts to those areas that need attention.

Of course, during the course of a complex project like an enterprise system implementation project, other problems may occur which were not obvious or anticipated from the start. Additional tool sessions may be needed along the project path to identify those problems.

The tool currently supports people with experience of implementing enterprise systems in judging a particular situation. On the other hand, the tool can be used as a learning tool for consultants. In academic and industrial education the tool can be used to visualise different scenarios. The tool is also considered useful in further research for setting up comparative case studies.

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